Gamifying Data Visualizations on Mobile Devices

Noopur Agarwal
Department of Design
University of San Francisco
San Francisco, CA 94117
nagarwal3@usfca.edu

Alark Joshi
Department of Computer Science
University of San Francisco
San Francisco, CA 94117, USA
apjoshi@usfca.edu

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Abstract
Increasingly, we are seeing a surge in a mobile-first approach to data driven journalism where data explorations are designed to work with a smaller form-factor. These interactive visualizations are informative and explanatory, but most use scrolly-telling as the interaction paradigm. In this position paper, we would like to draw attention to other more playful interaction paradigms, specific to mobile devices, and game design elements, that when paired could encourage frequent and joyful engagement with data.

Author Keywords
data interfaces, interaction, engagement, mobile devices, play.

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous; See [http://acm.org/about/class/1998/]: for full list of ACM classifiers. This section is required.

Introduction
There is an increasing trend of users interacting with data casually on their phones in situations where it is of personal relevance (banking apps, social apps, fitness apps, energy consumption apps, and so on) or personal interest (data-driven journalism). These storytelling interfaces are being built for consumption on mobile devices [4, 6, 8, 15]. In-

terestingly, most of the interaction expected from the user in such situations is through common touch gestures such as tapping, scrolling, and in some cases, pinch-and-zoom. While there is significant innovation with respect to data visualization for mobile platforms, we believe that we are not seeing the full range of possibilities with gestural inputs on a mobile device being paired with the representations.

In this position paper, we highlight other *interaction* paradigms on mobile devices and simple gaming paradigms to discuss whether we can incorporate both for more interactive visualizations on small screens. We further contemplate whether we can enable the ultimate selfie device, to allow users to create playful, gamelike, and expressive data selfies.

Related Work

In previous work on interaction with data for mobile devices, Langner et al. [10] have demonstrated the use of multiple mobile devices to interact with data for data exploration and analysis. The effective use of multiple devices to extend a display, offload interface elements, provide overview and detail increases the ability of users to explore data rapidly without losing context. Browne et al. [2] extended a sketch-based paradigm to interact directly with data on interactive whiteboards. A user can explore data by sketching on their interface that is similar to drawing on a whiteboard. This work was further extended to engaging story telling in the Sketchstory system [11, 12]. Spindler et al. [20] present a range of hybrid interaction paradigms for interacting with data on a big screen. Tablets are used as tangible elements that can provide detail [17], multiple views for comparison [18], translation/rotation of the data, and so on. Rzeszotarski and Kittur [16] introduced natural interaction using physics-based affordances in the “Kinectica” system. TouchPivot [9] facilitates data exploration on tablets through pen and touch interactions.

User engagement in interactive storytelling is particularly challenging. McKenna et al. [14] found that the user experience when interacting with a story can affect their engagement. They found that visualizations and animated transitions can positively impact a reader’s engagement.

Paradigms for Interacting with Data

Current paradigms for interacting with data include common touch gestures like tapping a data element to retrieve the value, pinch-and-zoom to explore a region closely and swiping to scroll through the data (scrolly-telling [5, 4, 21]).

Interaction through Tilting, Rotation, and Shake

Interaction with data could easily expand past touch gestures to include activity recognition with the use of the accelerometer, available on most smartphones. This would enable such things as tilting and rotating so users can explore data from different angles or planes. This has been seen in simple interface examples like the “Compass + Level” app [22] on the iPhone or “360 degree photos” on Facebook. The exploration of space that these interaction paradigms offer may allow users to visualize data from a different perspective. Successful mobile game apps such as “Doodle Jump” [19] are already using the built-in accelerometer in phones to create fun and engaging gaming experiences. In Doodle Jump users are asked to guide the character through various environments by subtly tilting their phone and beating other players’ high scores.

The accelerometer also enables a “shake” gesture that could be utilized to randomize and/or reset filters or other settings when exploring data. The shake gesture being rudimentary is often used in apps for simulating baby rattles and might open up possibilities in engagement with younger audiences [1] and data visualizations.

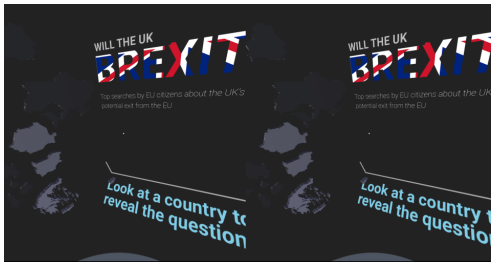

Figure 1: This screenshot shows a virtual reality interface that allows the use of a Google Cardboard to explore Google Trends data about the most asked question per country about the 'Brexit'.

Interaction through Virtual Reality
In addition to tactile interaction, virtual and augmented reality-based interaction through the use of mobile devices has been found in interfaces such as the "Will the UK 'Brexit'?" [23]. A user can find out the most popular query for each country in the European Union related to the 'Brexit' in this virtual reality app. By moving their head, a user can move the pointer to a different country and it displays the most popular 'Brexit' related query in that country.

GamePlay through Comparisons, Connections, and Rewards

We are seeing newer ways to increase engagement in data driven journalism by adding game design elements with such things as choices, discovery, rewards, competition and/or comparison. For example, a viewer may be required to predict something before the information is conveyed to the viewer. The process of requiring the user to interact with the provided data and then consciously predict the outcome/future based on their mental model, leads to increased engagement and, potentially, a deeper understanding for the reader. Figure 2 hows an application of such an

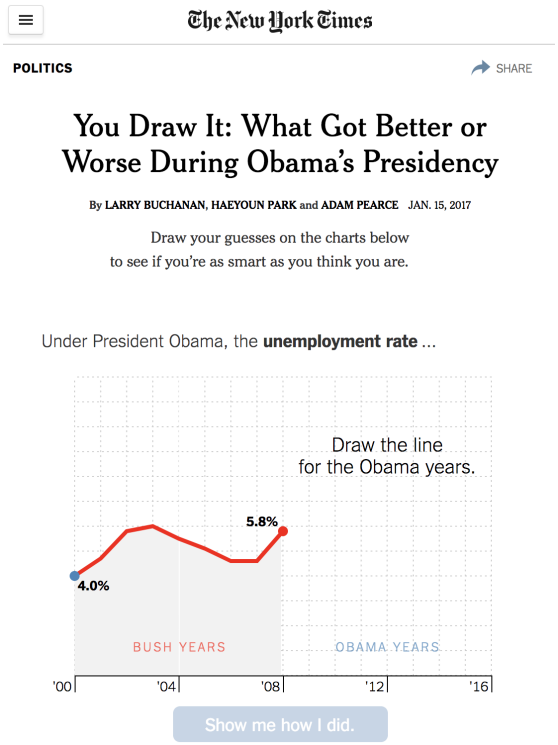

Figure 2: User engagement through prediction - In this example, the user is shown the unemployment rate during the Bush years in office and s/he is requested to draw a line predicting the unemployment during Obama's years. After the user has drawn the line, s/he can see the real underlying data by clicking on "Show me how I did".

approach from the New York Times that draws attention to President Obama's legacy. It requires a user to examine the provided information in the form of a graph and then predict

the trend by drawing on the screen. This is followed by the user being able to see the actual trend that then could lead to confirmation or contradiction for the reader. Such interactions can potentially affect a reader's perception and lead to higher engagement for the reader.

Game-like interactions have also be used to increase engagement in such examples as the New York Times Game of Thrones interactive chart [7] that allows users to place characters from the TV show on a Beautiful-Ugly scale as well as an Evil-Good scale. A reader can then explore the results from other participants to compare their results with them. The layered complexity of this challenge increases engagement where one has to consciously think about multiple aspects of the characters in the show and place them on the 2D-canvas as shown in Figure 3.

Discussion

Mobile game developers continue to exploit playful interaction paradigms with our mobile devices. Users have blown into their phones to simulate a flute or tilted their phone to avoid land mines. Could playful, interactive ingenuity that is possible on a mobile device be paired with data visualization in order to create the ultimate exploration tool? Playful interaction paradigms like blowing into your phone gain initial popularity because they are fun, but are not commonly seen. Is this because these interactions are asking too much of the user? If a user is engaging with a data visualization and is then prompted to "shake" their phone, would a user do so for the experience or would the playful interaction be the point of disengagement? Are developers not thinking about pairing these playful interactions with mobile data visualizations because simplicity is best in a format where one is always competing with the users environment? If data visualization in meant to simplify complex

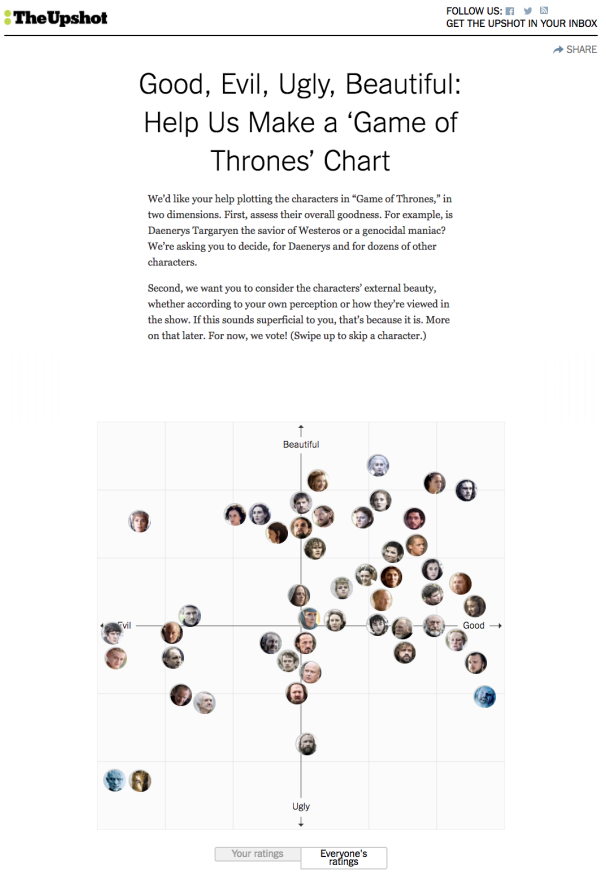

Figure 3: Engagement through playful interaction - In this example, the reader is asked to place various characters from the popular TV show Game of Thrones on the Beautiful-Ugly and Evil-Good scale. After the reader has interacted with the characters, they can compare their results with all the other readers who have participated in the interactive chart.

information does asking more of the mobile user just complicating things?

"Selfie" apps such as Snapchat and Instagram have made artists out of the everyday user. These apps made picture taking even more "fun" with interactivity like drawing and by "gamefying" these actions through counting / reward systems - the more photos you share / likes you get, the more trophies you unlock and so on. These selfie apps on our mobile devices allow us to document ourselves and compare with others in a creative, playful, and most importantly spontaneous way so much so that it is habit forming. Can we enable users to create data visualization selfies much like Frickbits[1] [3] attempted to do so? Would this take the form of a digital Dear Data [13]?

We believe that these and other mobile play-related paradigms could be further investigated to allow playful interaction with data to create data selfies.

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